

# The analysis of cardiac case interventions of medical rescue teams in the Brzesko district in 2010 and 2011. An analysis of emergency medical team interventions

(Analiza interwencji z przyczyn kardiologicznych podejmowanych przez zespoły ratownictwa medycznego w powiecie brzeskim w roku 2010 i 2011)

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**Abstract** – Introduction. Frequent paramedical emergency dispatch calls are caused by cardiovascular diseases.

The aim of the study was to analyse medical intervention for cardiological causes undertaken by medical rescue teams in the Brzesko area.

Materials and methods. The analysis covered 10,208 medical emergencies by medical rescue teams in 2010 and 2011, including 1,082 undertaken for cardiological reasons. The choice of criterion was a diagnosis based on ICD-10 procedures: I20-I25 - ischemic heart disease and I30-I52 - other heart diseases. Descriptive statistics and the nonparametric compliance  $\chi^2$  test were used for the analysis.

Results. Cardiovascular causes accounted for 10.6% of all ambulance departures. In 2011, there were 56 fewer dispatches due to cardiological reasons than in 2010. There were more than twice as many specialist team dispatches sent on call. The average travel time was within the requirements set forth in the Act. The reasons for calling for a medical rescue team varied, but mostly included chest pain and dyspnoea. Most of the interventions concerned rural areas and people over 61 years of age. There was an increase in deaths by 24% in the case of sudden cardiac arrest in 2011. Specialist teams used more procedures and medications than the basic teams.

Conclusions. Cardiac interventions are still a frequent cause for calling for an emergency medical team. Properly locating ambulances allows the mediating time of arrival of the units to meet the requirements specified by regulations. The type of intervention is dependent on the type of the team and the qualifications of their members do not affect the final outcome.

**Key words** - medical rescue teams, interventions, cardiac causes.

**Streszczenie** – Wstęp. Częstą przyczyną wezwań zespołów ratownictwa medycznego są choroby układu krążenia. Celem pracy

była analiza interwencji z przyczyn kardiologicznych podejmowanych przez zespoły ratownictwa medycznego w powiecie brzeskim.

Materiał i metody: Analizą objęto 10 208 kart wyjazdów zespołów ratownictwa medycznego i medycznych czynności ratunkowych z roku 2010 i 2011, w tym 1082 z przyczyn kardiologicznych. Kryterium wyboru było rozpoznanie na podstawie procedur ICD-10: I20-I25 choroba niedokrwienności serca, I30-I52 inne choroby serca. Do analizy zastosowano statystykę opisową oraz nieparametryczny test zgodności  $\chi^2$ .

Wyniki: Przyczyny kardiologiczne stanowiły 10,6 % wszystkich wyjazdów. W roku 2011 zanotowano o 56 mniej wyjazdów z przyczyn kardiologicznych w porównaniu z rokiem 2010. Ponad dwukrotnie częściej do wezwań wysyłany był zespół specjalistyczny. Mediana czasu dojazdu mieściła się w wymogach określonych w ustawie. Przyczyny wezwania zespołu ratownictwa medycznego były zróżnicowane, przeważały: bóle w klatce piersiowej i duszność. Większość interwencji dotyczyła obszarów wiejskich i osób po 61 roku życia. Odnotowano wzrost zgonów o 24 % w przypadku nagłego zatrzymania krążenia w roku 2011. Zdecydowanie częściej niektóre procedury i leki były stosowane przez zespoły specjalistyczne.

Wnioski: Interwencje z przyczyn kardiologicznych nadal są częstą przyczyną wezwania zespołu ratownictwa medycznego. Właściwe rozmieszczenie ambulanсів umożliwia dostosowanie mediany czasu dojazdu zespołów do wymogów określonych w ustawie. Rodzaj podejmowanych interwencji jest zależny od rodzaju zespołu, a kwalifikacje ich członków nie mają wpływu na rezultat końcowy.

**Słowa kluczowe** – zespoły ratownictwa medycznego, interwencje, przyczyny kardiologiczne.

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- A. The idea and the planning of the study
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## I. INTRODUCTION

The emergency medical system provides assistance to anyone who is in a state of emergency [1]. The most important element of the system are paramedical rescue service teams (EMS), which are divided into the basic (B) and specialized (S) teams. One B Team includes at least two people eligible for medical emergency services, including a system of nurses or paramedics, and an S team consists of at least three people, including a doctor, nurse and paramedic [1,2]. In the medical rescue system's organization, the number of available ambulances in the area and their locations are to ensure the shortest possible time of arrival at the place of the event. The maximum time for reaching the EMS should be no more than 15 minutes in a city of over 10,000 inhabitants and 20 minutes outside of a city with over 10,000 inhabitants [1,2]. The knowledge and skills of people employed in the medical rescue system and their experience have a direct impact on the health and lives of the patients.

The type of team dispatch is determined by the dispatcher on the basis of the interview and collected medical information given by the person calling for help [1]. In dealing with a patient in a life threatening situation, it is important for witnesses to undertake immediate action and to instruct the team after calling them. Failure to take on action and a delay after calling for qualified help increases the risk of death in the pre-hospital phase. The time from

the moment of calling for the EMS to the moment of completing the intervention on the patient determines further treatment. Access to early defibrillation, team arrival time, team member knowledge and experience, and ambulance equipment standards are also very important.

Both in Poland and in European Union countries, a cardiovascular disease is a common reason for calling for EMS. Though in Poland since 1999 there has been a systematic decline in cardiovascular diseases, standardized mortality rates are twice as high as those in Western Europe [3,4].

Taking into account the organizational changes of the medical rescue system in Poland in the recent years and the continual high rate of cardiovascular diseases, research has been undertaken to analyse the interventions of medical rescue teams based in the Brzesko district region. Brzesko district is located in the north-eastern part of the Małopolskie region, covering an area of 591 km<sup>2</sup> with a population of 91.6 thousand residents.

## II. MATERIALS AND METHODS

The study included 10,208 medical emergency travel reports, including 1,082 for cardiac reasons. Women accounted for 53.1% and men 46.7% of the study group. The average age of the respondents was 67.9 years, with 71.4 for men and 63.9 for women. The largest group (31.5%) were people 71-80 years of age, and the least number (1.6%) were those over 90 years old.

The work involved a retrospective analysis of medical records, which were the records and medical history documents recording the departures of the emergency medical rescue teams and the documents describing medical emergency procedures. From among the 10,208 documents issued in 2010 and 2011, we selected the documents describing cardiac intervention by the medical rescue teams according to the ICD-10: I20-I25 procedures for cardiomyopathy and procedure I30-I52 for other cardiac diseases. Data obtained from 1,082 EMS documents and emergency medical procedure documents were analysed in detail.

A data analysis was performed using Microsoft Excel 2003 using descriptive statistics and the nonparametric compliance  $\chi^2$  test. Due to the type of analysed data and the fact that we assume some generalizations related to the non-uniformity of the groups and the different number of individuals in them, the degree of significance was determined at  $\alpha = 0.1$ . The research was carried out at the Independent Public Health Care Team in Brzesko,

Małopolskie region with the consent of the Director of this institution.

### III. RESULTS

Medical rescue teams were summoned for cardiac reasons 1,082 times, which accounted for 10% of all trips in the analysed period. In 2011, there were 148 more trips as compared to 2010, but 56 fewer (5.2%) due to cardiac reasons. More than half of the calls were to people aged 61-80 (52.13%) and to women (53.1%). Less frequently, the teams were called to people over 90 years of age (1.57%) and 20-40 years old (6.38%). More and more often, special teams (69.2%) were dispatched to the calls, and the interventions concerned village inhabitants (Table 1).

Table 1. Medical cardiac deaths of cardiac causes in 2010 and 2011, taking into account the type of the team and location of the call

Year	Team S				Team P				Overall trips	
	city		country		city		country			
	n	%	N	%	n	%	n	%	n	%
2010	153	14.2	232	21.5	52	48	132	12.1	569	52.6
2011	112	10.3	252	23.3	39	3.7	110	10.1	513	47.4
Total	265	24.5	484	44.8	91	8.5	242	22.2	1082	100.0

The average arrival times of the medical rescue teams were in line with the requirements of the regulations and came out to 4 in the city and 9-10 in the country. On the other hand, the average times of intervention of medical rescue teams during the analysed period were within the "golden hour" range.

Reasons for calling an emergency rescue medical team varied, including: chest pain (71.16%), dyspnoea (36.51%), palpitations (16.64%), syncope (7.21%), and cardiac arrest (28%). On location after the call, the medical rescue team made 13 different diagnoses using the ICD-10 classification. Heart failure was dominant (40.76%) (Table 2).

Table 2. Type of diagnosis according to the ICD-10 as identified by the medical rescue team according to gender

Diagnosis according to the ICD-10	Women		Men		Total	
	n	%	n	%	n	%
I20 - painful dyspnoea	28	4.87%	31	6.11%	59	5.45%
I21 - Severe heart attack	59	10.26%	83	16.37%	142	13.12%
I23 - Pericardial hematoma as a complication occurring during acute myocardial infarction	1	0.17%	0	0.00%	1	0.09%
I24 - Other acute forms of ischemic heart disease	13	2.26%	17	3.35%	30	2.77%
I25 - Chronic ischemic heart disease	57	9.91%	58	11.44%	115	10.63%
I44 - Atrioventricular block and left bundle branch	1	0.17%	3	0.59%	4	0.37%
I45 - Other circulation disorders	0	0.00%	1	0.20%	1	0.09%
I46 - Circulation failure	19	3.30%	49	9.66%	68	6.28%
I47 - paroxysmal seizure	34	5.91%	18	3.55%	52	4.81%
I48 - Atrial spasm and flutter	111	19.30%	43	8.48%	154	14.23%
I49 - Other cardiac arrhythmias	19	3.30%	17	3.35%	36	3.33%
I50 - Heart failure	238	41.39%	203	40.04%	441	40.76%
I51 - Heart disease not accurately identified and other complications of heart disease	0	0.00%	1	0.20%	1	0.09%

The data does not add up to 100% because some people had more than one type of disease.

Sudden cardiac arrest occurred in 128 people, 65 in 2010 and 63 in 2011, representing a total of 1.2% of all emergency trips and 11.8% of cardiac arrests during the analysed period. More than half of all cases (53%) of cardiac arrests occurred due to cardiac causes, mostly in men (72%) and people over 61 years of age. A medical team was sent to 80.4% of the cases. Prior to the arrival of the rescue team, in 60% of the cases, no resuscitation activities were performed by witnesses of the incident. Rescue measures in sudden cardiac arrest in 36 cases ended with the patient's death, including 16 in 2010 and 20 in 2011. Patients who managed to have their circulation or both circulation and breathing restored were transferred to the nearest hospital emergency department or haemodynamics laboratory.

Our analysis showed statistical significance between the cause of the team's call and the type of team sent on dispatch. In 2010, this involved cases of nausea and chest tightness, so the B team ( $p = 0.0038$ ) and the S team ( $p = 0.0954$ ) were sent to high blood pressure incidents. In 2011, however, none of the reasons for the call were statistically significant for both the *specialist and the basic teams*.

In 2010, the teams performed 2,064 medical procedures, and in 2011, they performed 1,968 procedures. The statistics of the analysis showed that the S teams more often performed medical procedures such as: *medical advice, consultation, assistance, injection of antibiotics and other medicinal substances, medical laboratory tests*, whereas the B team statistically more often performed procedures such as: *other medical procedures not listed, oxygen therapy and ECG with 1-3 leads, giving advice, support staff, pulse oximetry, and systemic blood pressure monitoring* (Table 3).

Table 3. Medical procedures performed by medical rescue teams in 2010 and 2011

Procedure Code	Procedure name	2010				P - Value	2011				P - Value
		Team B =Basic		Team S =Special-ized			Team B		Team S		
		%	N	%	N		%	N	%	N	
89.00	Medical advice, consultation, assistance	2.2	4	93.2	359	<0.0001*	3.4	5	98.6	359	<0.0001*
99.219	Injection of antibiotics and other medicinal substances	16.8	31	46.8	180	<0.0001*	21.5	32	49.5	180	<0.0001*
99.99	Other medical procedure not listed	60.9	112			<0.0001*		69	36.8	134	0.2629
93.964	Oxygen therapy	40.8	75	20.8	80	<0.0001*	28.9	43	22.0	80	0.4324
89.511	ECG with 1-3 leads	37.5	69	8.2	70	<0.0001*	26.2	39	19.2	70	0.3845
89.02	Medical Lab tests	0.0	0	3.4	13	0.0954*	2.0	3	3.6	13	0.8376
89.03	Giving advice, assistance personnel	95.7	176	9.9	38	<0.0001*	78.5	117	10.4	38	<0.0001*
38.99	Piercing veins - other	0.5	1	0.8	3	0.9919	32.2	48	0.8	3	<0.0001*
89.7	Physical examination	0.0	0	0.8	3	0.6959	11.4	17	0.8	3	<0.0001*
89.63	Monitoring pulse oximetry	-	-	-	-	-	10.1	15	0.0	0	<0.0001*
38.93	Catheterizing a vein - other	0.0	0	0.3	1	0.9235	3.4	5	0.3	1	0.0338*
89.54	ECG monitoring	-	-	-	-	-	4.7	7	0.0	0	0.0006
99.97	Pharmacological treatment	-	-	-	-	-	4.0	6	0.0	0	0.0020*
89.61	Monitoring systemic blood pressure	-	-	-	-	-	10.1	15	0.0	0	<0.0001
89.602	Pulse oximetry	-	-	-	-	-	3.4	5	0.0	0	0.0063

\* Indicates statistically significant parameters - no data

During treatment interventions, patients were treated with 24 types of medications. Table 4 only shows the medications that had a relationship between their use and the type of team. Among the statistically significant drugs, 7 were administered more frequently by the S team in 2010 and 6 of them in 2011. The B team more often used aspirin (Polopirin), nitro-glycerine and midazolam (Sopodorm) (Table 4).

Table. 4. Type of medicine administered by the medical rescue teams

Types of drugs	Year 2010		Value p statistic $\chi^2$	Year 2011		Value p statistic $\chi^2$
	Team B n-184 (%)	Team S n-385 (%)		Team B n-149 (%)	Team S n-364 (%)	
Plavix 300 j	0 (0.0)	14 (3.6)	0.0765*	1 (0.7)	6(1.6)	0.8614
Heparin 5000 j	1 (0.5)	36 (9.4)	0.0012*	5(3.40)	25 (6.9)	0.4994
Plavix 600 j	1 (0.5)	19 (4.9)	0.0694*	2(1.3)	17(4.7)	0.8614
Nitro-glycerine	60 (32.6)	84 (21.8)	0.0534*	46(30.9)	73 (20.1)	0.0737*
Furosemide	5 (2.7)	2 (13.5)	0.0011*	5(3.4)	61(16.8)	0.0007*
Captopril 12.5	9 (4.9)	50 (13.0)	0.0324*	10 (6.7)	46(12.6)	0.2818
Sopodorm	2 (1.1)	47 (12.2)	0.0002*	7(4.7)	49 (1.5)	0.0393*
Ketonal	3 (1.6)	52 (13.5)	0.0002*	1(0.7)	36(9.9)	0.0038*
Hydroxyzin	2(1.1)	14(3.6)	0.3977	0 (0)	29 (8.0)	0.0056*
Polopirin 300mg	51 (27.7)	85(22.1)	0.5365	41(27.5)	61(16.8)	0.0531*

\* Indicates statistically significant parameters

The statistical analysis did not show a relationship between the types of procedures performed and the qualifications of the members of the team.

The end result, which included deaths, the place of transporting the patient or referral for further treatment depended on the type of team. In 2010, three final effects were statistically significant depending on the specialist group: *transport of the patient to the ER* ( $p < 0.0001$ ) or to the *haemodynamics laboratory* ( $p = 0.0139$ ) and *referral to primary health care* ( $p = 0.0053$ ). In 2011, one final effect was statistically significant: *referring the patient to their primary care physician* ( $p = 0.0019$ ), which was more frequently applied by the specialist team. There was no statistical relationship between patient death, hospitalization and the type of intervention team.

## IV. DISCUSSION

The authors' research has confirmed that other emergency medical teams are still often intervening for cardiac reasons [5,6,7]. The main reason for calling a medical rescue team was chest pain. In many studies, authors concluded that chest pain is a predominant symptom in cardiac disorders and is the most often cause of medical emergencies [8,9,10].

The relationship of cardiovascular diseases with gender and age was also shown [11,12,13,14,15]. In the analysed material, the teams were more frequently dispatched due to cardiological reasons for women older than 61, whereas sudden cardiac arrest was more common among men in comparable periods of life. The results obtained in our studies are supported by available publications, which indicate higher incidents of sudden cardiac arrest among men [16,17,18].

The team's arrival time is one of the more important prognostic factors in cardiovascular disease [1,2]. In patients with cardiac arrhythmias where defibrillation is applied, any delay of 1 minute reduces the patient's chances of survival by 10% [19]. In our personal research, low median values were obtained for the time of arrival for both urban (4 minutes) and out-of-town (10 minutes) dispatches. Much higher average travel time was obtained in many other studies [6,20,21]. According to Hubert et al., travel time has shortened over the years, e.g. in 1998 it was 15.5 minutes and in 2003 it was 11.4 minutes [22]. This can be attributed to better locations for ambulances.

An important element of the analysis was the relationship between the type of team available to respond to the event and the cause of the call. In 2010, statistically significant values were identified for the cases of *nausea and chest tightness*, to which the specialist team was sent, and for *high blood pressure*, to which the basic unit was sent. The analysis of the relationship between the type of group and procedures performed showed that in 2010, the specialist team most frequently gave *medical advice* (93.2%) and *injections of antibiotics and other medicinal substances* (46.8%), whereas the basic team gave *advice by assistance personnel* (95.7%).

No statistical significance was demonstrated in the case of the ECG procedure with 12 or more leads, where the percentages of this procedure were comparable in both groups (B team - 89.7%, S team - 88.1%). In 2011, there were 11 statistically significant procedures. The most statistically significant values were obtained for 7 procedures, including 5 performed exclusively by basic units, i.e. *pulmonary monitoring*, *ECG monitoring*, *pharmacological treatment*, *systemic blood pressure monitoring and pulse*

*oximetry*. It can be assumed that the specialist team's documentation (where the team leader is a physician) did not include all procedures performed. More detailed descriptions and a number of procedures were included on emergency medical documents provided by the basic teams.

In the analysed period, statistically significant correlations were found in the occurrence of procedures and the type of medical rescue team. The documentation often noted the procedure used as *other medical procedures* and nothing else was further described in the list. It is therefore difficult to determine what actions are hidden under this code. From the analysed documentation, it can be concluded that the diligence of the descriptions as well as knowledge of the codes used to write the documentation were not always the same in the case of interventions by both basic and specialized teams.

Other authors point to the importance of cardiac procedures performed by the EMS. Authors emphasize the importance of performing a 12-lead ECG record, and often also its teletransmission [21,23].

The relationship between the type of medical rescue team and the drugs administered was also analysed. In the analysed period, 22 types of drugs and 2 types of infusion fluids (0.9% NaCl and IV, intravenous fluid) were reported. In 2010, statistically significant values were reported for such drugs as Plavix 300j, Heparin 5000j, Plavix 600j, Nitroglycerin, Furosemide, Captopril, Sopodorm and Ketonal. In the case of Sopodorm and Ketonal, there is a statistically significant relationship between the use of these drugs and the type of EMS. In 2010, all drugs that were statistically significantly were most often administered by specialist teams. In 2011, a statistically significant association was observed for using Polopyrin 300, Nitroglycerin, Furosemide, Sopodorm, Ketonal and Hydroxine. Drugs such as Furosemide, Ketonal and Hydroxine were more commonly used by specialist teams, while Polopirin, Nitroglycerin and Sopodorm were administered by the basic team.

Personal material noted that Plavix, in two doses of 300 µg 600 µl were used in the pre-hospital study. Plavix 300 was used by basic team (0.7%) and specialist team (2.6%). as Plavix 600 j used by basic team (0.9%) and specialist team (4.8%). In the available literature, we have confirmed the use of acetylsalicylic acid and clopidogrel as the current standard for STEMI patients [24]. S. Steinhubl et al. Emphasize the importance of early oral antiplatelet therapy prior to PCI [25]. Also, S. Yusuf et al. Indicate the importance of early therapy with clopidogrel and aspirin in patients with MI [26]. S. Sabatine has achieved positive results with clopidogrel and aspirin and a 20% reduction in ischemic complications [27].

No statistical significance has been demonstrated for oxygen and morphine use by medical rescue teams. In the available publications, authors point to the problem of analgesic treatment in pre-hospital treatment and recommend the use of narcotic drugs as the golden rule [28,29,30]. V. Bounes et al. recommend the use of narcotic analgesics in accord with standard procedures, particularly in cases of severe pain that may be present in cardiac cases manifested as acute chest pain [31]. Our personal studies show that Ketonal was used by 11.1% of the specialist team calls and morphine in 7.6%. No statistically significant association with the use of morphine and Pyralgin was observed with respect to the type of syndrome, but it was demonstrated with the use of Ketonal.

Personal material noted that the use of analgesics was not always consistent with current standards and practices. Special teams rarely used morphine and more often Ketonal in cardiovascular intervention. J. Szyller et al., based on the analysis of 20,408 medical emergency documents, showed that 76% of all interventions and 18.7% of patients with chest pain, the EMS used medical morphine [32]. The recommended treatment for cardiac pain is morphine [31]. It is found on the list of medicines that can be administered by medical rescuers without a medical order [1,2]. Despite the possibility of using morphine to alleviate pain in cardiologic interventions, our studies showed it was used in only 7.6% by the basic teams.

The authors' own studies showed that in 60% of sudden cardiac arrests, witnesses did not undertake resuscitation activities before the arrival of a medical rescue team. Similar results were obtained by other researchers. The research conducted by M. Roman and M. Gaca showed that only 19.8% of cases had resuscitation actions prior to the arrival of the rescue team [33], 12.6% in J. Januszewski's research [34] and 30% according to M. Bartczak et al. [35]. Resuscitation by a witness of the event significantly increases the patient's chances of survival [1,5,10].

The authors' own research, a statistically significant difference was found between the end results of resuscitation and the type of medical team. In 2010, the statistical significance was related to the three end effects, i.e. the *patient's transfer to the ICU*, the *transport of the patient to the haemodynamics laboratory from the place of incidence* and *referring the patient to the general physician*. In 2011, however, the case concerned *referring a patient to a general physician*. In both analysed years, a statistically significant difference was found between the final effects and the interventions of the specialist team.

In case of patient-fatality interventions or refusing hospitalization by the patient, no statistically significant relationships were recorded. In both of these cases, the end result

was not dependent on the type of intervention on the patient.

The majority of patients (82.7%) completed the referral to the nearest ICU. In the analysed period, the number of patients transferred to the haemodynamic laboratory from the place of occurrence increased. 37 patients were admitted in 2010 and 49 patients in 2011. In the case of specialist teams, this number was comparable in both years, with baseline rates increasing from 3 in 2010 to 13 in 2011. Similar results were obtained from other authors who showed that patients after emergency medical service intervention due to cardiological reasons ended up in the ICU or Haemodynamics Laboratory [5,6,33]. Interventions of emergency medical teams ended in 3.3% of cases. In a study conducted by M. Kózka et al., a comparable mortality rate of 3.2% [6] was reported.

## V. CONCLUSIONS

- Cardiovascular interventions accounted for a significant percentage of all ambulance trips, and were significantly more frequent in rural areas among people over 61 years of age. In 2011, there was a slight decrease in the number of cardiac arrests due to cardiac causes compared to 2010.
- The reasons for a person calling for assistance allow the dispatcher to decide on sending a medical specialist team.
- The proper distribution and location of ambulances in the Brzesko district allowed the teams to adjust to the average arrival time according to the requirements specified by law.
- The average times of intervention by emergency medical teams in cardiac cases were within the "golden hour" range.
- In the event of sudden cardiac arrest in 60% of cases, no rescue action was undertaken by witnesses of the incident.
- An increase in deaths in sudden cardiac arrest in 2011 was observed as compared to 2010.
- Access to the haemodynamic laboratory enabled more cardiac patients to be referred to them rather than to the SOR.
- The type of interventions and the final outcome depended on the type of intervention team. More and more often, specialist teams used certain procedures and medicines.
- The qualifications of the members of the core team did not affect the type of intervention.

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